LiF Fabrication and Physics Package Assembly for NIF EOS Targets

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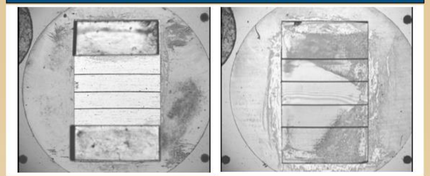
Abstract

Lithium Fluoride (LiF) is used in target fabrication to construct physics packages for National Ignition Facility (NIF) Equation of State (EOS) targets. LiF material is diced and then polished for direct use on EOS target packages or used for diamonds cutting precise parts.

The difficulty is in machining the LiF part to meet thickness and form specifications. Precise specifications for thickness reduce the uncertainty in the analysis of the data taken during the target shot. Assembly can be challenging when the part form is out of specification.

❑ Material ❑ Polishing ❑ Dicing ❑ Assembly ❑ Metrology

LiF Material and Assembly for EOS Target Physics Packages



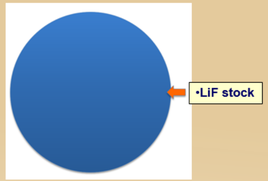
LiF windows for Al EOS | LiF step for LiF EOS

Processing and Assembly Challenges

Issue	Investigation
Initial Polish	Raw material (25mm diameter X 1mm thick) is polished to desired thickness (oversize by 80-100 um if final polish is required)
Dicing Parts	Material is diced with a diamond saw. Dicing oversize by 250-300um to allow for final edge polish.
Edge Polish	Remove 250-300um of material from 4 edges to remove cracks. Parts are blocked together to improve part uniformity.
Final Polish	Polishing leaves a 1-2um burr along edges. Top and bottom surfaces are lightly polished to remove 20-40um.
Polish Form	Top surface needs to meet specification for flat and smooth surface, and square edges.
Diamond Turning	Reference Schafer Corp. 50um cutting tool. LiF step from polished part. Cu ablator. (See poster "Fabrication of Equation of State (EOS) targets with submicron tolerances for the NIF" by Mariusz Lament and Carlos Castro)
Part Form	Curved surface creates challenge for assembly. Thickness variation creates uncertainty in physics data.
Part Assembly	Uniform layer of glue to achieve less-than 1um glue gap. Shape of part after assembly.
Assembly Form	After gluing parts together, the part is changing shape. Typically forming a 2-3um curve or bowl-shape.

Initial Polish

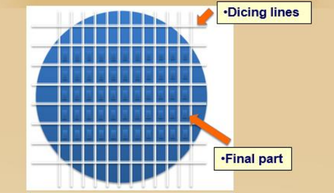
❑ Raw LiF material (25mm diameter X 1mm thick)
❑ Initial polish to desired thickness.



Raw LiF stock

Dicing Parts

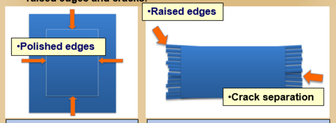
❑ Diced oversized by 250-300um with a diamond blade.



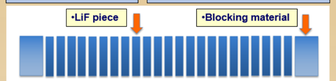
Over sized dicing pattern

Edge Polish

❑ Preferred method for blocking LiF to facilitate edge polishing.
❑ Oversized part is edge-polished to final dimension to removed raised edges and cracks.



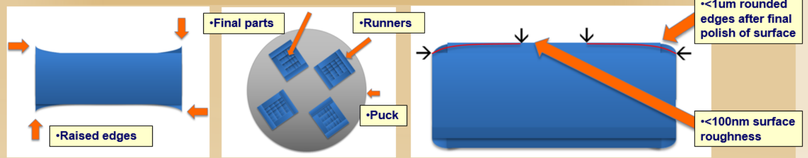
Parts oversized | Raised edges and cracks



Blocking LiF Pieces

Final Polish

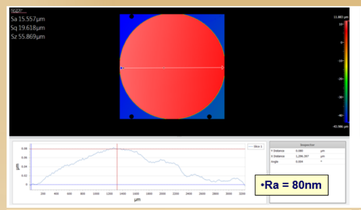
❑ Remove raised edges after polish to final dimension.
❑ After finishing surface polish part is rinsed in solvent to remove wax residue.



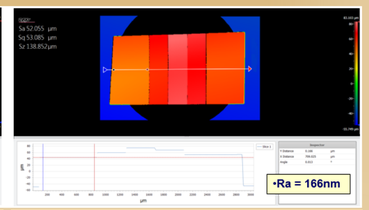
1-2um raised edges on part | Parts blocked on glass puck | Metrology of Final Form and Thickness

Diamond Turning

❑ Diamond turning process reference Schafer Corp.
❑ Ra lineout showing the form of copper ablator and LiF step parts before assembly.



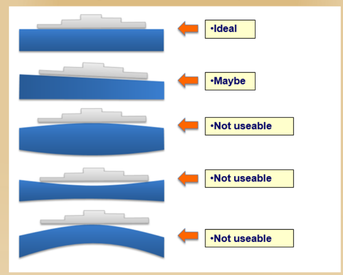
Copper ablator form with single lineout



LiF step part with single lineout

Part Form

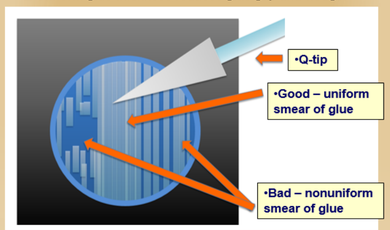
❑ Ideal glue gap of <1um requires a flat and uniform thickness surface meeting 50nm half-width-half-max specification.



LiF step piece on copper ablator

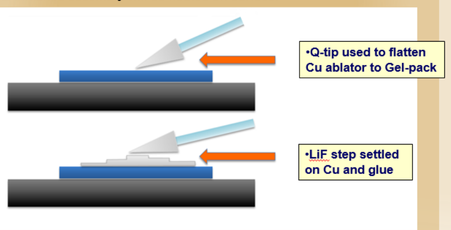
Part Assembly

❑ Application of <1um thick glue layer to Cu ablator
❑ Uniform glue thickness reduces glue gap and wedge.



Glue application with Q-tip

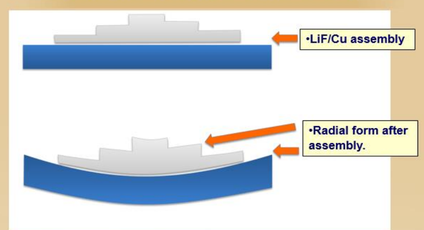
❑ Copper is flatten to a firm tacking surface before glue application.
❑ Finished assembly will be floated off surface.



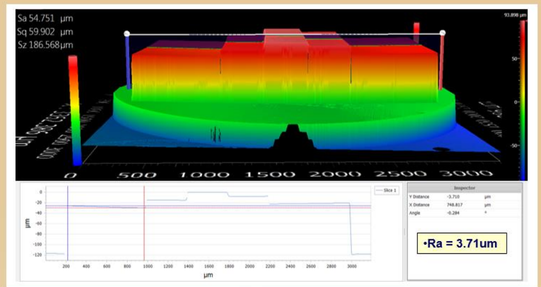
Gluing LiF Step to Copper Ablator

Assembly Form

❑ LiF/Cu form has a large curve after assembly.
❑ After gluing the LiF step to the Copper ablator the assembly changes form, typically to a spherical or cylindrical shape.



LiF and Copper Form after Assembly



LiF EOS form shown with a single lineout

Continued Investigation

❑ LiF and Cu parts are flat in form before glue assembly.

❑ Glued assembly shows a significant form change.

❑ Glue application and glue gap thickness is successful.

❑ LiF cutting and polishing produces precise parts.

❑ Parts are analyzed for thickness uniformity across the whole surface.

❑ Type of glue is being investigated for shrink rate affect on assembly.

❑ Specification requirements for part form is being investigated.

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